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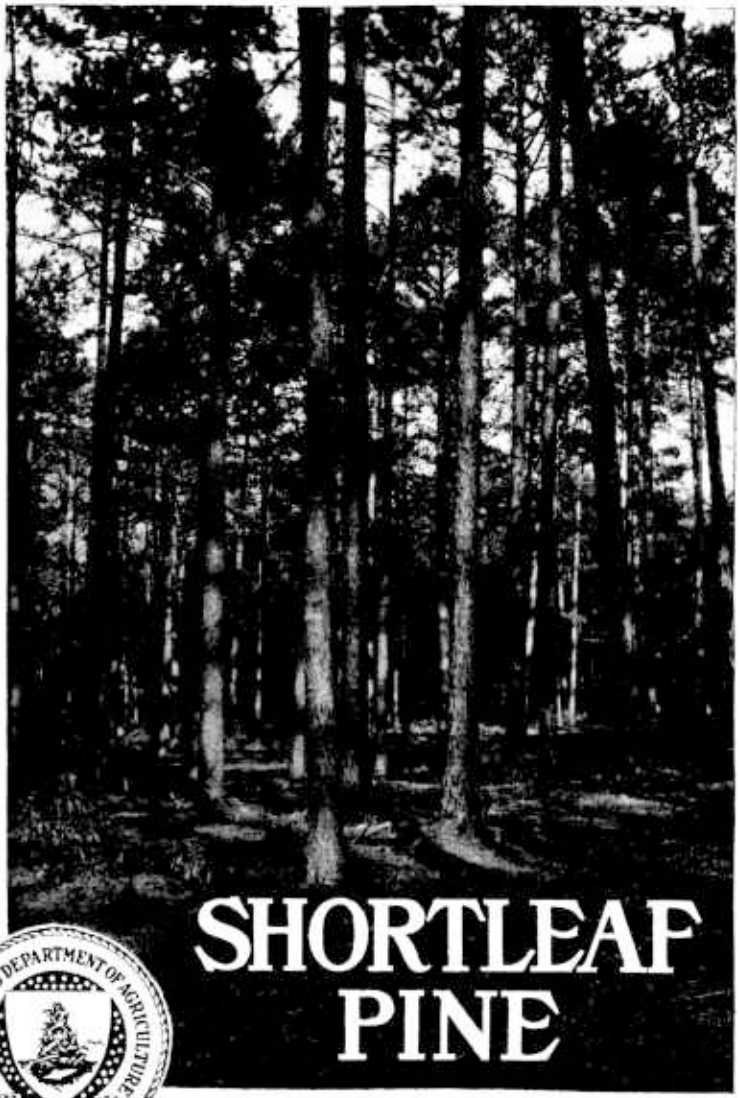

SHORTLEAF PINE

TIMBER is an agricultural crop—grown from the soil. Timber will be needed in the future; therefore young trees are valuable now.

Timber is a local and national necessity, and the people will pay enough for it to cover the cost of production plus a fair profit to the grower.

Timber is a farm savings bank to be drawn upon in times of extra need. If we check on it only to the extent of cutting the growth, or interest, the capital remains untouched and the investment continues undiminished. Thrifty growing timber rightly protected and cut often yields more profit than money at 6 per cent interest.

Timber growing is usually not a major project on the farm, but timber products often bring in a substantial part of the farm income.

Better methods of soil building and intensive soil cultivation have diminished the need for clearing up new lands for crop production. This favors the growing of timber as a crop on the less fertile or more broken parts of the farm, and makes it a part of the regular farm program.

Shortleaf pine is one of the most profitable forest trees to grow as a crop over a large area of the uplands and mountains from New Jersey to Georgia and west to Oklahoma and Texas.

This bulletin is a revision of and supersedes Farmers' Bulletin 1534, Shortleaf Pine Primer.

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SHORTLEAF PINE

By WILBUR R. MATTOON, *Extension Forester, Forest Service*

CONTENTS

GROWING SHORTLEAF PINE AS A CROP

SHORTLEAF PINE (*Pinus echinata* Miller), or shortleaf yellow pine, has certain features which make it a desirable and profitable tree to grow as a crop. It grows rapidly, produces high-quality, soft-textured wood, and easily perpetuates itself by means of an abundance of seed and also, if the young pines are killed back, by sprouting up vigorously from the ground to form another forest.

Shortleaf pine grows well on the uplands, including the piedmont and the lower mountain sections, from New Jersey south and west to eastern Oklahoma and eastern Texas.

Timber is an essential material for successfully operating the farm—for houses, barns, fences, telephone poles, and fuel wood. Some parts of nearly every farm are broken, steep, or worn-out lands, best suited to timber as a crop and also most profitable when used for that purpose. The farm timberland, in addition to supplying farm needs, often produces a surplus of timber products for sale in the market. Well-managed farm woodlands have many times been the means of changing the farm balance sheet from loss to profit. The growing of timber on the farm is justified as a farm enterprise.

Good forest practice means, for the most part, protecting the land at all times from fire and rightly using the ax and saw. The aim of this bulletin is to offer suggestions that may be helpful in the growing of shortleaf pine as a profitable crop.

> Timber will always be needed for operating the farm—for houses, barns, fences, telephone poles, and firewood.
>
> A rational farm program includes growing timber for home use and for sale.

What is "shortleaf" pine?

The true shortleaf pine is known also as yellow pine, and, in some places, as rosemary pine. In the coastal-plain region from North Carolina to Louisiana the term "shortleaf" is often applied to the

loblolly pine to distinguish it from the longleaf pine, as both loblolly and longleaf are often found growing together.

The true shortleaf pine finds its home in the piedmont section and on the lower slopes of the Allegheny Mountains. It grows in well-drained clay or gravel loams and therefore is found on ridges and on warm, south-facing slopes. It is found in 24 States, from the south-

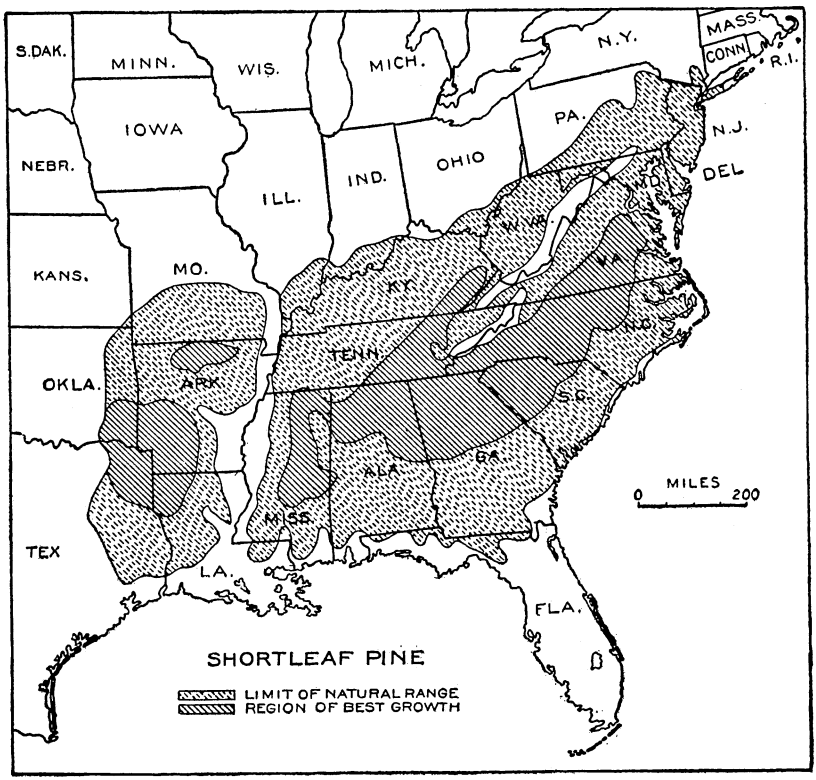

FIGURE 1.—Map showing the range of shortleaf pine

ernmost part of New York, through New Jersey, Pennsylvania, West Virginia, southern Ohio, southern Indiana, southern Illinois, Missouri, southeastern Kansas, eastern Oklahoma, and eastern Texas, and all the States east and south of these. The botanical range and the territory in which it is commercially important are shown in Figure 1.

How can you tell shortleaf from other pines?

The leaves, or straws of shortleaf pine are mostly from 3 to 5 inches in length and occur in clusters of either two or three. On vigorous branchlets clusters of three leaves prevail. The sand pine of Florida and southern Alabama has similar leaves, but they occur always in clusters of two leaves each. The loblolly pine, shortleaf's most abundant associated pine, regularly has three leaves in a cluster. The cones, or burs, of shortleaf are mostly about 2 inches long, with very fine prickles on the cone scales. When open and on the tree

they look to be the size of small pullet eggs. The trunk is remarkably straight and clean, "as smooth and straight as the mast of a Salem clipper—a pleasure to the eye and to the sawmill man." Unlike all other important commercial pines, shortleaf pine sprouts vigorously when cut or burned back during early life, and thus successfully reproduces itself.

TIMBER GROWING ON THE FARM MEANS:

Improving woodlands by right methods of cutting and protection

Reforesting vacant and unprofitable farm lands

Using farm-grown timber to the best advantage

Marketing home-grown timber at a fair profit

How can the farm forest be made more profitable?

The chief reasons for failure to make farm woodlands profitable are lack of good management, failure to protect them from fire and excessive grazing, ignorance concerning methods of cutting and local timber values, and undeveloped markets. The owner must know how to handle his woods and market the product if the forest tract is to be made profitable. (Fig. 2.) Wherever forest land is close to centers of consumption, numerous examples of profitable management can be found. Generally in the eastern United States the value of timber is now such as to make its production as a crop bring a fair net return on the investment.

GROWTH OF TREES

How fast do shortleaf pine trees grow?

Shortleaf is a rapid to moderately rapid growing pine.

Its rate of growth depends a great deal on the region and the local conditions. Often associated with loblolly pine, red oaks, hickories, and sweet gum, shortleaf pine maintains its place in the "mixed forest." It grows best and most profitably, however, in pure stands; that is, stands composed only of shortleaf pine. In this manner it occurs extensively, coming up in abandoned fields and in openings in the woods.

Many measurements have been made of the trees in pure pine stands fully stocked with trees (i. e., no open spaces). Here the growth of the individual tree is less than it would be in the open, but the growth in close stands returns the largest yield of wood per acre.

The average size of the trees at different ages grown in fully stocked stands is shown in Table 1, and also the average number of trees per acre. It is obvious that the better the land the more rapid the growth, and the poorer the land the slower the growth. This

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FIGURE 2.—Thrifty stand of shortleaf pines making rapid growth as the result of complete protection from fire. The ground cover of young trees and other plants is beneficial in shading the ground

also applies broadly to whole regions of the country. For example, at high altitudes and in the more northern and more southern parts of the range of shortleaf pine the rate of growth of trees is relatively slow. So all kinds of land on which growing stands were measured have been thrown into three classes, namely, good, average, and poor. In measuring the stands no account was taken of the very slow-growing trees—stunted, dying, or "suppressed" trees—all of which should have been thinned out. The better-growing or "dominant" trees were studied and measured. These amount to about two-thirds of the total stand of trees—less in young stands and more in older stands.

Shortleaf pine trees in fully stocked stands at an age of 30 years, for example, on good land should average about 63 feet in height and 8.8 inches in diameter (at breast high); on average quality land, about 49 feet and 6.6 inches; and on poor quality land about 35 feet in height and 4.8 inches in diameter. A fully stocked stand 30 years old, on average land would contain about 505 larger, or dominant, trees per acre, which would be about two-thirds of the total number of trees.

In most calculations it is best to use the column for average land (Table 1). Trees at 40 years of age on average land will be found to be about 61 feet in height and 8.4 inches in diameter.

TABLE 1.—*Rate of growth of shortleaf pine trees in fully stocked or fairly crowded stands, on three grades of land and at different ages*

Age of trees	Height of trees [1]			Diameter of trees (at breast height) [1]			Number of trees per acre	
							Thrifty or dominant trees	Trees 4 inches and over in diameter
	On good land	On average land	On poor land	On good land	On average land	On poor land	On average land	On average land
Years	*Feet*	*Feet*	*Feet*	*Inches*	*Inches*	*Inches*	*Number*	*Number*
15	33	26	19	4.6	3.5	2.5	1,075	[2] 330
20	44	34	25	6.1	4.5	3.2	850	[2] 780
25	54	42	30	7.5	5.5	4.0	675	990
30	63	49	35	8.8	6.6	4.8	505	825
35	71	55	40	9.9	7.5	5.5	390	660
40	78	61	44	10.9	8.4	6.1	320	545
45	85	66	47	11.8	9.1	6.8	275	460
50	90	70	50	12.6	9.8	7.3	245	405
55	95	74	53	13.3	10.4	7.8	220	360
60	99	77	55	14.0	11.0	8.3	200	330
65	103	80	57	14.6	11.5	8.7	190	300
70	106	82	59	15.2	12.0	9.1	175	280

[1] The very slow growing trees—sickly, overtopped or suppressed—were not measured or included. The more promising, or dominant, classes of trees only were measured. These comprise about two-thirds the total number of trees.

[2] At this age only the very fastest growing trees in the stand have reached a size of 4 inches or over in diameter.

One point should not be overlooked, namely, that shortleaf pine averages small in the size of the individual trees, but naturally grows in crowded stands of many trees per acre. Thus its yield of timber or wood per acre or growth per acre is relatively high.

What factors determine the rate of growth?

The health of the tree is all important in determining its growth. (Fig. 3.) Trees can be starved because of lack of food and water. To make their own food, pines require little besides water and sunlight. The pines as a class can thrive on soil that would be too deficient in potash, phosphoric acid, and nitrogen for most of the hardwood trees like the oaks, poplar, walnut, maple, beech, and hickories. But a hard, dry soil prevents proper root development and root activity. The tree is stunted as a result. Trees may be overcrowded so that even on good soil there is not enough moisture for each, and also not enough sunlight. Fire is a powerful agent in checking the rate of growth, if in fact it does not kill the tree. This subject is treated further on pages 35 to 37.

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FIGURE 3.—Timberland owners discussing with a forester the rate of growth and the management of shortleaf pines. A knowledge of what makes trees grow and how to keep the woods thrifty and safe from fire and insects is essential in using land most profitably

Do tree trunks lengthen?

Yes; but only by new growth at the top. Once the side limbs are formed or set, they remain in that same position throughout the life of the tree, or until they die and drop off. All limbs or branches from the main trunk reach to the heart or center of the tree.

SCALING LOGS

What is a log scale rule?

A scale or rule which shows how many board feet can be cut from logs of various sizes. Most commonly, the diameter of the log in inches is measured inside the bark at the small end, and the length in feet over all.

Does it make any difference what log rule is used for measuring and selling logs?

Yes; a great difference both in the amount of timber and in the resulting money return.

The Doyle rule, although in common use in the South, is unfair to the seller for logs below about 28 inches in diameter. In the early days of large and cheap virgin timber, when narrow and knotty boards were worthless, it was fairly satisfactory, but for scaling small-sized timber, such as second-growth southern pine, it gives such small volumes for small logs as to make it unsatisfactory. On the national forests the Scribner rule (in the decimal C form) is standard. It is more fair than the Doyle rule for small logs, but reasonably careful sawing should result in obtaining from 10 to 20 per cent more lumber than even this rule gives for second-growth timber.

TABLE 2.—*The contents of logs, in board feet, scaled by the International log rule (using saw cutting ¼-inch kerf)*

Diameter at top end of log inside bark (inches)	Length of log in feet						
	8	10	12	14	16	18	20
	Contents of log in board feet						
6	7	10	13	16	19	23	27
7	12	15	19	24	28	33	39
8	16	21	27	33	39	45	52
9	23	29	36	43	51	59	68
10	29	37	45	54	64	75	86
11	36	46	57	68	80	92	105
12	44	57	70	83	97	111	127
13	52	68	83	100	116	133	151
14	62	80	98	117	136	156	176
15	73	94	114	136	157	180	204
16	84	108	131	156	181	207	233
17	96	123	149	177	205	235	265
18	110	139	169	201	232	265	299
19	123	156	190	225	261	297	335
20	138	174	212	251	290	330	372
21	152	193	234	279	321	366	412
22	168	214	259	307	354	404	453
23	186	235	285	337	388	442	497
24	203	257	311	367	424	481	542

TABLE 3.—*The contents of logs, in board feet, scaled by the Doyle log rule*

Diameter at top end of log inside bark (inches)	Length of log in feet						
	8	10	12	14	16	18	20
	Contents of log in board feet						
6	2	2	3	3	4	4	5
7	4	5	7	8	9	10	11
8	8	10	12	14	16	18	20
9	12	16	19	22	25	28	31
10	18	22	27	31	36	40	45
11	24	31	37	43	49	55	61
12	32	40	48	56	64	72	80
13	40	51	61	71	81	91	101
14	50	62	75	87	100	112	125
15	60	76	91	106	121	136	151
16	72	90	108	126	144	162	180
17	84	106	127	148	169	190	211
18	98	122	147	171	196	220	245
19	112	141	169	197	225	253	281
20	128	160	192	224	256	288	320
21	144	181	217	253	289	325	361
22	162	202	243	283	324	364	405
23	180	226	271	316	361	406	451
24	200	250	300	350	400	450	500

For small timber, such as second-growth pine, the International log rule (Table 2) gives log volumes which are very close to what can be sawed out by using good methods. Careless sawing will give a lower volume of square-edged boards than the logs scaled by this rule, so that it gives the millman a chance to test his own efficiency in this respect. Producers of small logs will benefit when this or some equally close rule has come into general use. The sale of logs by the International rule is recommended.

As a comparison, a log measuring 10 inches in diameter inside the bark at the small end and 16 feet long, when carefully sawed with a circular saw of ordinary thickness (¼-inch kerf) should, accord-

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FIGURE 4.—Scaling the contents of a log in board feet, using a log scale stick. Measurements are taken inside the bark at the smaller end of each log

ing to the International rule, turn out 64 board feet. For the same log the Doyle rule (Table 3) would show 36 board feet or only about one-half the amount that can be actually sawed and that is credited to it by the International rule.

How are logs scaled?

The diameter of the small end of the log inside the bark is measured in inches, and its length taken in feet. If a scale stick is used, the contents of the log are read directly from the stick. (Fig. 4.) Otherwise it can be read from tables, such as Table 2 or 3. These readings are for straight and sound logs. Thus, the scaling of sound and straight logs is a simple matter.

Experience and special knowledge are required to determine the allowance that should be made for defective logs. The problem is to ascertain how much deduction from the scale should be made to equal the loss resulting from hollow centers, rot, crook, and other defects. Observations at a sawmill should help, as does also assistance from an experienced scaler. Defect often requires deductions of 5 to 10 per cent, and sometimes as much as 15 to 20 per cent of the scale.

ESTIMATING STANDING TIMBER

What is meant by the volume of a tree?

The volume of a tree is its contents, usually expressed in terms of board feet of lumber, cords of wood, crossties, or cubic feet. It is customary to include only the merchantable contents of the trunk between the stump and the top that is left in the woods. Saw logs are cut from the trunk down to 5 or 6 inches in diameter, while pulpwood or excelsior wood can include all pieces down to 4 inches, and firewood all down to 2 inches.

How many board feet of saw timber can be cut from pine trees of various sizes?

Much depends upon the degree of care exercised, the kind of saw used, and the amounts taken from and left in the woods. The International rule (page 8) shows what can be sawed from logs with a circular saw cutting a ¼-inch kerf, all the usable lumber being taken. This rule, applied to shortleaf pine trees, shows not what is now being cut by wasteful methods but what should be taken to meet the present conditions of scarcity and high price of lumber.

TABLE 4.—*Saw timber contained in shortleaf pine trees of various sizes, if cut and utilized closely. (Cut with circular saw—scaled by the International log rule)*

Diameter of trees outside the bark at breast height, or 4½ feet above ground (inches)	Number of 16-foot logs in the tree (to a 5-inch top diameter)					
	1	2	3	4	5	6
	Board feet in the tree					
6	14	20	25	----	----	----
7	16	27	40	----	----	----
8	18	34	54	74	----	----
9	20	41	69	96	----	----
10	23	48	84	119	157	----
11	24	56	101	142	189	----
12	26	63	118	168	223	----
13	28	71	135	195	258	----
14	30	80	153	224	296	----
15	32	88	171	253	337	----
16	33	97	190	284	378	471
17	35	106	211	317	424	527
18	37	116	232	352	472	588
19	39	127	255	390	523	654
20	40	137	281	430	578	724
21	42	148	308	473	634	796
22	43	160	337	517	695	873
23	----	173	369	563	758	954
24	----	----	397	611	825	1,038

To estimate the contents of a tree, the diameter outside the bark (at breast height, or 4½ feet above the ground) and the number of 16-foot cuts are ascertained. (Fig. 5.) For example, a tree measuring 16 inches in diameter (outside the bark at breast height) and having three 16-foot log lengths will cut out about 190 board feet, as shown by Table 4.

Various kinds of tree-scale sticks, or "cruising" sticks, are coming into use. They are used to measure the diameter and the height, or the number of logs, in a tree. One is known as the Biltmore stick. Some of the sticks also show for trees of different diameters and number of 16-foot cuts, the number of board feet of saw timber that can be cut out. (Fig. 6.) Information as to sources of tree-scale and log-scale sticks and their use can be obtained from your State forestry

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FIGURE 5.—With a handy tree-scale stick the diameter of a tree (at breast height) is being measured. The same stick has a scale for measuring the height, or number of 16-foot log cuts, and shows also the number of board feet in the tree

department, the extension service of your State college of agriculture, or the Forest Service, United States Department of Agriculture.

TIMBER PRODUCTION PER ACRE

Is it possible to predict the amount of timber an acre will grow?

Many stands of shortleaf pine of known ages have been studied and measured to find out how much timber they will yield per acre. In this the forester deals with fully stocked stands, or those which have no blanks or spots without trees. The quantity of timber is measured in the standing trees, either in cords, crossties, or lumber. With the figures so obtained it is possible to predict the rate of growth and the quantity of timber there should be on an acre at different ages.

How many cords of wood will an acre of shortleaf pine produce?

A fully stocked stand of shortleaf pine 25 years old on poor land should cut out per acre about 15 cords (with the bark on), on average land about 31 cords, and on good land about 42.5 cords. (Table 5.) The average growth is thus a little over a cord a year. In peeled

FIGURE 6.—Estimating the saw timber in a pine tree by the use of a tree-scale or cruiser's stick: A, If the stick is held horizontally against the trunk of the tree at a specified distance from the eye, the observer is able to read directly the diameter of the tree outside the bark. The standard is called the "breast-high" diameter and is taken at a height of 4½ feet above the average level of the ground. B, The stick is graduated so that, when held a specified distance from the eye of the observer who stands a specified distance from the tree, the observer can read the number of 16-foot-log lengths in the tree. The principle is that of two similar triangles

wood, such as is often wanted for paper pulp and excelsior, it will be seen in Table 5 that an acre of average land will produce just about a cord a year in stands between the ages of 25 and 65 years; also the highest average rate of production of cordwood comes when the trees are between 40 and 50 years old.

TABLE 5.—*Cordwood yield per acre of shortleaf pine stands of different ages (fully stocked stands, or about maximum yield)*

[Includes the wood from all trees 4 inches and over in diameter]

Age of trees	Wood with bark			Peeled wood		
	On good land	On average land	On poor land	On good land	On average land	On poor land
Years	*Cords*	*Cords*	*Cords*	*Cords*	*Cords*	*Cords*
15	15.0			12.0		
20	29.5	18.5		24.0	14.5	
25	42.5	31.0	15.0	35.0	25.0	12.0
30	54.0	41.0	23.0	45.0	33.5	18.5
35	64.0	49.0	30.0	54.5	40.5	24.5
40	73.0	56.0	33.0	62.5	47.0	29.0
45	80.5	61.5	39.5	69.0	51.5	32.5
50	87.0	66.0	43.0	75.5	56.0	35.5
55	93.0	70.0	45.5	80.5	59.5	38.0
60	97.5	73.0	47.5	84.5	62.5	40.0
65	103.0	76.0	49.0	88.0	65.5	41.5
70	105.0	78.5	51.0	91.5	67.5	43.0

The number of trees required to cut a cord at any given age of the stand can be easily calculated from the last column of Table 1. For example, at 30 years of age on average land, fully stocked shortleaf stands contain about 825 trees per acre. There are about 505 of the larger, or dominant trees, and about 825 trees of all sizes 4 inches and over in diameter. If the stand on average land at that age cuts about 41 cords (column 3 of Table 5), the average tree will cut out about one-twentieth of a cord, or it will require about 20 trees to make a cord.

How much saw timber will an acre of shortleaf pine produce?

The owner or the prospective buyer of timberland should know its capacity for producing timber. Fortunately, the amount of shortleaf pine timber that can be grown per acre can be predicted because of studies which have been made of many well-stocked, "well-set," or dense, stands. (Fig. 7.) The values shown in Table 6, however, are for stands that have been burned over frequently. The table shows the amount of saw timber that such stands may be expected to cut at various designated ages. The figures do not include the timber removed in previous thinnings, or the intermediate yield, often a very considerable amount.

An acre of average-grade land, well set in shortleaf pine, for example, as shown in Table 6, in 30 years should cut out an average of 6,245 board feet if all the trees measuring 7 inches and over are sawed. If the logs were scaled by the Doyle rule, and only the trees that measure 9 inches and over in diameter at breast height were counted, the timber on the acre would scale only about 750 feet. But the scale shown by the Doyle log rule is too low, and the cut would actually be much more.

Shortleaf pine, when grown in well-set or dense stands and protected from fire, should grow an average of a cord a year per acre, or from 300 to 500 board feet a year per acre.

Such well-set and protected stands on average land at ages of about 20 to 40 years should grow about 2 cords an acre yearly, or from 500 to 800 board feet.

At 40 years, a fully stocked acre of shortleaf pine on good land should cut about 30,225 board feet, an average of about 755 board

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FIGURE 7.—A roadside demonstration established by a lumber company to show the growth of shortleaf pine. The signboards tell the rate of growth per acre in cords and board feet; number of trees before and after thinning and the profit in the timber as a crop.

feet per year; on average land 16,110 feet, or an average of about 400 board feet yearly; and on poor land about 4,525 feet, or an average yearly growth of 110 board feet. These illustrate well the wide differences in growth due to different conditions of soil and climate. For example, almost all the southern half of Arkansas would be classed as good, whereas the dry clay hills of the upper parts of North Carolina, South Carolina, and Georgia would be average, and the firmest soils poor in quality.

A caution here is advisable. These figures show what would be the yield if all the trees were sound and straight. A liberal allowance for seen and unseen defects in the logs is very necessary, or the scale will be much too high.

TABLE 6.—*Lumber yield, in board feet, from 1 acre of shortleaf pine trees from fully stocked stands*

Age of trees (years)	Yield in board feet					
	Trees 7 inches and up in diameter, mill scale or actual cut			Trees 9 inches and up in diameter, by Doyle log rule		
	On good land	On average land	On poor land	On good land	On average land	On poor land
20	3,440	225	----------	295	----------	----------
25	9,685	2,535	----------	1,750	70	----------
30	17,105	6,245	815	4,570	750	----------
35	24,435	10,860	2,535	8,635	2,005	70
40	30,225	16,110	4,525	12,600	3,985	410
45	35,475	20,815	6,790	16,435	6,395	910
50	40,045	24,615	8,960	20,440	8,670	1,600
55	43,890	27,785	11,220	24,180	10,790	2,300
60	47,285	30,320	13,485	27,405	12,600	3,215
65	50,045	32,580	15,565	30,325	14,445	4,175
70	52,580	34,570	17,195	32,825	16,260	5,060

The right use of the ax and saw and the protection of the land at all times from fire are the keys to the problem of growing timber profitably as a crop.

THINNING GROWING PINES

Why are thinnings necessary in growing pines as a crop?

As in a stand of corn or cotton, the trees in a full pine stand crowd upon each other, and the stronger trees gradually crowd out the weaker. (Fig. 8.) Too few trees on an acre result in bushy tops and knotty lumber; too many trees mean a slowing up of individual growth. There is a right number, varying with the age and location, to obtain the best growth of the largest number of trees. Thinnings are made to keep ahead of nature and reduce the number of trees, so as to obtain the maximum growth for the kind of product desired.

How should thinnings be made?

There are two ways of thinning pine stands. In a "low" thinning (fig. 9) the smaller, less vigorous, diseased, and unpromising trees are taken out. Low thinning favors the largest and best trees and more nearly keeps the timber production at its capacity. Size and quality count much in the value of the timber. The first principle is to wait until the trees to be removed have reached a merchantable size, so that the thinning may at least pay for itself, or, better still, make a profit. The material removed may be used for firewood, pulpwood, excelsior wood, or small saw timber. Shortleaf pine will be large enough for a first thinning at ages generally from 15 to 20 years. An idea of the number of trees per acre in full stands of different ages can be obtained from the last column of Table 1. This is only an approximate estimate. This method of thinning is the one that should always be used in thinning young pines.

In a "high" thinning the larger or dominant trees are cut, thus making more room for the smaller trees to expand. (Fig. 10.) The most common practice of owners is to cut out the largest trees, because they are the first to become merchantable. What happens then is the recovery of the formerly stunted trees to a normal growth. This adjustment usually requires from one to two years, during which there is some loss in the growing power of the land. Thinning by this method (of cutting out the largest trees) permits of a good money return every 10 years or so, a feature which appeals strongly to the farmer or other owner of timberland.

Does shortleaf recover its rapid growth after suppression?

Yes; it is one of the most responsive of all the important timber pines to a recovery of rapid growth following thinning. Almost immediately after the thinning of an overcrowded stand of trees, the remaining trees begin to grow at a faster rate. (Fig. 11.) On good soils the recovery is particularly rapid. This capacity helps to make shortleaf pine a good crop to grow. The increase in growth will be found recorded in the wider rings of wood, known as annual rings of growth. To a surprising degree a study of the annual rings reveals the events in the history of the stand.

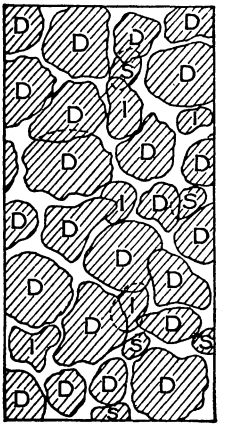


FIGURE 8. — How the tops of the trees in an unthinned overstocked stand shade the ground. In this 20-year-old stand there are about 500 dominant or thrifty trees, D; 100 intermediate or half-thrifty trees, I; and about 150 suppressed or dying trees, S, on an acre

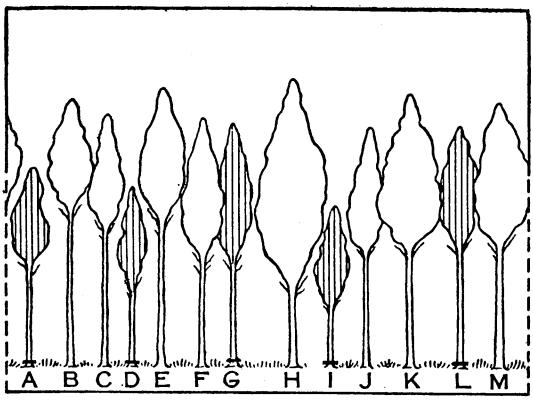
Should thinnings of pine be made in the summer?

Thinnings can be safely made at any time of the year except during the period from April to September, when certain beetles are active. These beetles are attracted to the freshly cut pine timber and often attack the near-by living trees. On page 42 will be found additional information on this subject.

What are the important wood products cut in thinning pine stands?

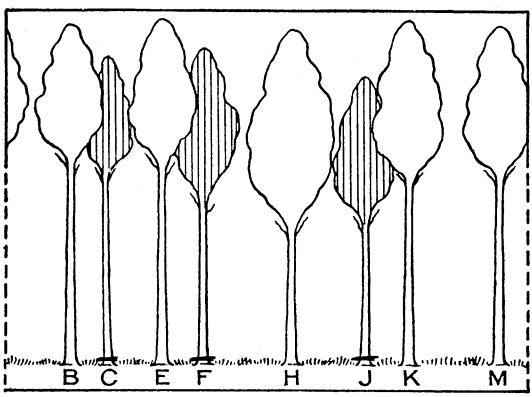
Pine wood is extensively in demand and is used for fuel on the farm and in the town. Every part of the tree is usable down to 2 inches in diameter. Probably the next most general market is for crossties, which, after they are creosoted, the railroads use in large numbers. (Fig. 12.) Trees often bring in a considerable part of the cash income for the farm each year. Many treating plants are now creosoting small round peeled pine posts, making them good for 10 to 20 years' use in the ground. The paper-making industry of the South in its mills from Maryland to Texas consumes thousands of cords of pine wood daily in making brown kraft paper. (Fig. 13.) The wood is bought by the standard cord of 128 cubic feet or the long cord of 160 or 180 cubic feet. It is also used in different regions for making excelsior, keg or band staves and heading, and mine timbers.

The larger or more select trees find various uses as poles, piling, and saw timber, much as does the main crop of trees, as discussed in the following paragraphs. The cutting of small-sized trees for saw



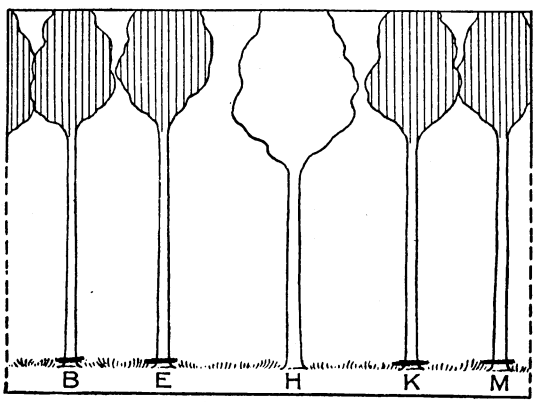
THINNING

Age of the trees, 20 years. A light thinning is to be made by cutting out the smaller, slower-growing trees. This will still keep the bigger trees slightly crowded to force them to grow upward instead of growing outward and becoming bushy



THINNING

Age of trees, 30 years. Another thinning is to be made now of the smaller, less vigorous and less promising trees



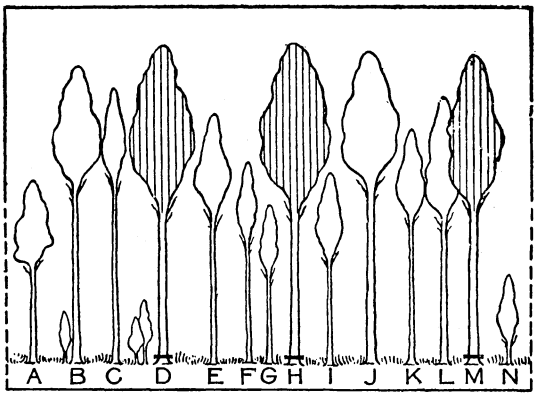
FINAL CUTTING

Age 40 years. The final cutting is made of all trees except one, H, a vigorous, bushy-topped tree, which is left to produce seed and restock the land. About three such trees are left growing on each acre until the land is well reset with young trees

FIGURE 9.—Low method of thinning or cropping. The smaller, less vigorous, and defective trees of this even-aged stand are cut out every 10 years, giving space for the stronger trees to grow. The thinnings produce small saw logs, pulpwood, posts, or firewood; the final cut produces saw timber or piling of good size, good grade, and high value. The trees to be cut are marked with vertical lines. (Note.—The letters A, B, C, etc., are used to identify the trees.)

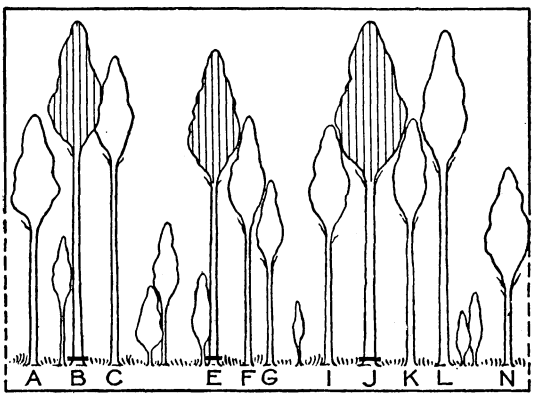
THINNING

Appearance before logging in 1908. The largest trees are to be cut out and used or sold



THINNING

Before logging in 1918. The growth of the trees since 1908 can readily be noticed. The trees to be cut are about the same size as those cut in the previous logging



THINNING

Before logging in 1928. As before, little trees keep coming in to fill the openings made by the cut trees. The trees cut will average between 30 and 40 years of age

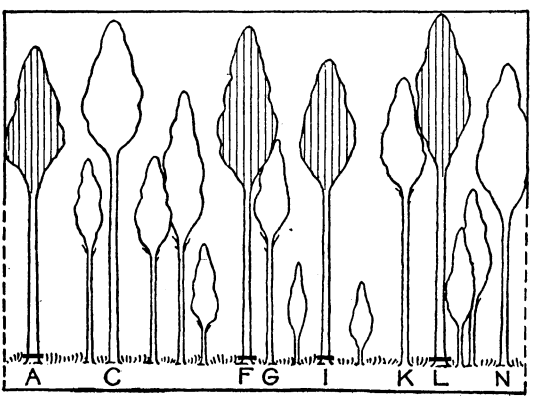


FIGURE 10.—High method of thinning or cropping. The trees are of many different ages. Every 10 years the largest trees are cut out, which gives space for others to grow to take their places. This method of cutting is common practice. The trees to be cut are marked with vertical lines. Compare with Figure 9. (Note.—The letters, A, B, C, etc., are used to identify the trees.)

logs entails a financial sacrifice that is not generally recognized. Size and quality count for much in the money value of trees.

CUTTING THE MATURE CROP

When should the main timber crop be cut?

If the stand has been successively thinned by the "low" method (fig. 9) it will mature with a relatively few trees per acre—80 to 150, depending upon the age and growth—suitable for saw timber, poles, or piling and of good size, good grade, and high value.

Many considerations should enter into a decision as to when the main crop of shortleaf pine trees should be cut and another started. The kind of product to be cut depends upon such factors as the location of the timber with reference to the best markets, prevailing prices of the various commodities, and cost of marketing the product.

FIGURE 11.—The story of thinning out shortleaf pine trees is recorded in the annual rings of growth of this tree. As the wide rings near the center show, the young tree had plenty of space to grow. Then the trees became crowded and growth was slowed up. But shortly after the stand was thinned the tree again grew vigorously and added a good volume of wood each year

What is the right way to cut the main crop of shortleaf?

Before cutting the stand, on each acre, from three to five trees capable of producing large crops of seed should be selected to remain standing. The number will vary with the size of the trees. (Figs. 14 and 15.) A shortleaf pine seed tree should be not less than 9 inches in diameter at breast height, healthy, as young as possible, and with a vigorous, full, or limby top. Such trees have usually grown in the open or apart from others. So that they will not be cut by the sawyers, these seed trees should be spotted with white paint or whitewash, uniformly on the same side of all the trees. With these "seed trees" and with adequate protection from fire, a full stand of young growth should become established on the tract during the next two to three years after logging.

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FIGURE 12.—Products from sap pines, mostly thinnings: A, Cutting up stove wood, a product widely used; B, hauling cut crossties, an important cash crop; C, peeled pine fence posts, 3 to 5 inches in diameter, ready for creosoting

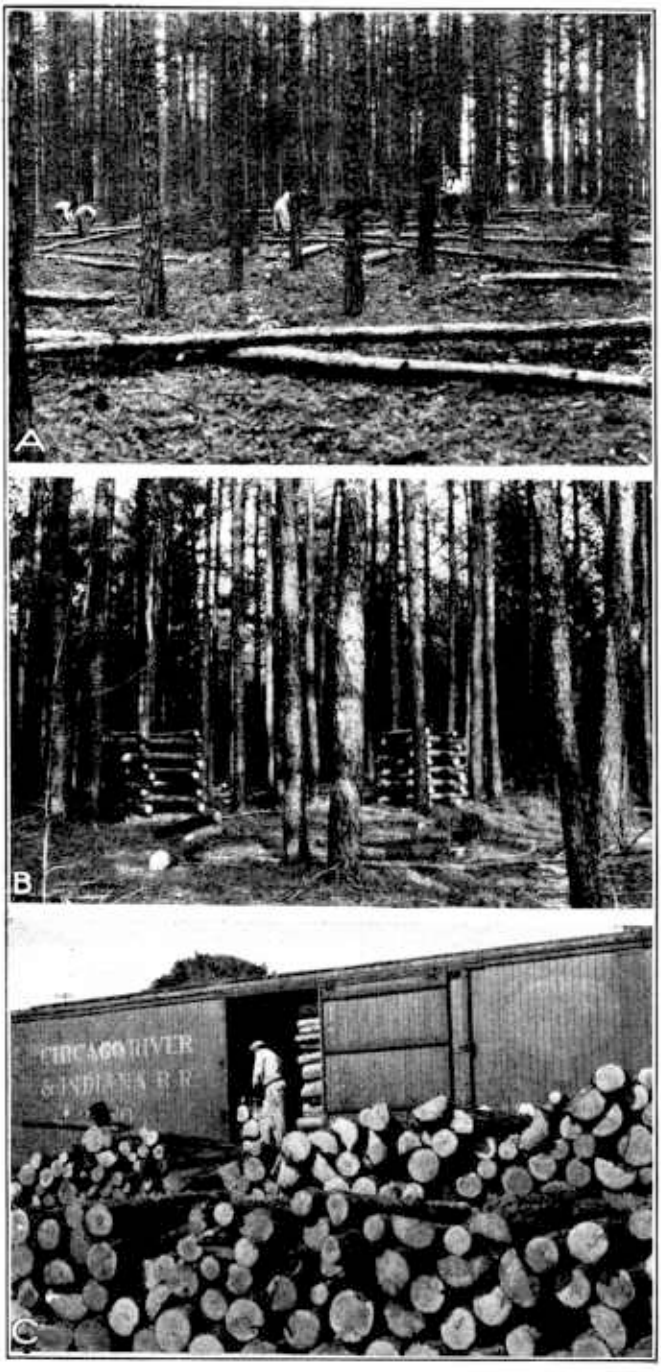

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FIGURE 13.—Many pine trees are cut and sold as pulpwood for making wrapping or kraft paper: A, Thinning the stand for pulpwood; B, pens of pulpwood piled for drying; C, loading pulpwood for shipment to paper mill

F13818A AND F177235

FIGURE 14.—The crop of shortleaf pine has been cut. A, Plenty of seed-bearing trees were left, and the ground is well stocked with young trees. They are thrifty sprout trees and came up after the fire killed back the small seedling trees. B. The owner has practiced conservative cutting for many years. The largest trees have been cut for logs, and the tops are being worked up into firewood. The trees left for a later cut will grow rapidly and be very profitable for lumber besides seeding up the land

Figure 16 shows how a pine stand may be cut in successive strips so as to get some timber out every year or every 5 or 10 years, as desired. Seed trees are left at each cut, so there is a series of different-aged young pines coming on.

F174178 AND F174479

FIGURE 15.—Wasteful logging. A, A heavy seed-bearing shortleaf pine which should have been left to restock the land. B, By wasteful cutting of high stumps, the lumberman left on 1 acre 1,080 board feet of timber. This was the best timber on the tract and worth enough to pay for the logging.

A good way to start another crop of pines without delay is to cut the trees in the fall just after a heavy crop of seed has matured. Logging makes a favorable seed bed and stirs up the seed in the soil. If the market conditions for the cut product are favorable at that season, this method of cutting all the trees and restocking the land may well be used wherever possible.

Important rules for good logging of shortleaf pine are:

Protect the woodland from fire at all times.
Leave three to five large-topped trees on each acre as seed trees. (Fig. 14.)
Cut the stumps at approximately the same height in inches as the diameter of the tree, but none higher than 12 inches.
Use the top logs to a small diameter for No. 3 saw logs, pulpwood, or firewood.
Throw each tree carefully, so as to do the least injury to the young growth.
Leave no dead tops against the trunks of any living trees, and so avoid infestation from insects or "worms."

Remember that, except in making improvement cuttings, the logging of small timber is an unprofitable business. This is because of the high cost of sawing and logging small logs and the low grades and low market value of the product.

Does it pay to hold second-growth timber and let it grow?

That can not be answered for any specific case or tract of timber. In general, however, the owner who has been conservative of his timber and not "let 'er go on the first offer," has profited. Small timber for saw logs is very unprofitable. The Doyle scale, the prevailing rule in the South, gives only a fraction of the scale that is now cut out, and the buyer pays a low rate per thousand feet for small logs. This is because felling, skidding, loading, and sawing

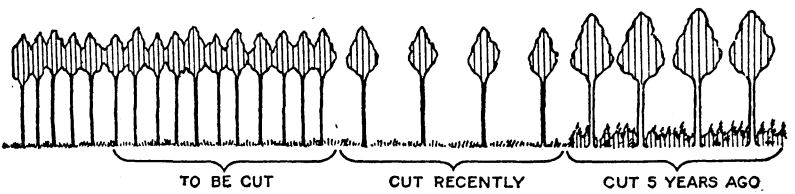

FIGURE 16.—Cutting the mature crop of trees in successive strips, one strip every 5 or 10 years. Three or four bushy-topped trees are left on each acre to reseed the land. Note that an abundance of seed fell from the trees left in logging and resulted in a complete restocking of the land with small trees. The seed trees left are no longer needed and may be cut. They have been growing rapidly under the stimulus of plenty of light and water and have made the owner a good profit

costs are much higher per thousand board feet than for large timber and there is a big waste in slabs. Much small timber is being worked up in mills at a substantial loss to the operator, while the whole sawmill operation, because of wasteful methods and low-grade logs, pays barely enough to buy "white meat and overalls" for the workers.

What happens when pine timberland is cut clean?

Almost everyone nowadays has seen large-sized areas of pine cut clean for firewood, pulpwood, or other product and has noticed that scarcely anything but scrub oaks, sweet gum, hickory, or sassafras came in on the land. Clean cutting of a pine stand ruins the chances of growing another valuable timber crop, except by the expensive method of planting small trees. The exception would be small areas of strips not more than 150 feet in width that are bordered by pines of seed-bearing age. It is a serious mistake to cut pinelands clean of all trees.

SELLING TIMBER

How should an owner sell timber?

A profitable way of marketing timber is to cut and haul the rough products to the mill, railroad, or other market. By rough

products is meant saw logs, billets, blocks, poles, posts, or cordwood. In this way the farmer should get profitable employment for himself or his men, and his teams, and secure for himself the profits that would go to the purchaser if the timber were sold standing. In some cases other methods of selling may be best.

How may timber be sold on the stump?

In any one of four ways—by the lump or "boundary," or after the timber is cut; by log scale; by sawed-lumber scale; or by the piece, stack, or cord. If timber is to be sold by lump or by boundary on the stump, the owner should first make an accurate estimate. He should know fully what he has in the tract and what is the fair value of the timber. Selling standing timber by a mill tally of the lumber cut is one method used as the values of timber rise. A better way is to sell by an accurate log scale, such as the International, which helps toward complete use of the timber. Unscrupulous buyers are ready to take advantage of those who do not know the amount and value of their timber. Buyers are entitled to no more than a fair profit. The farmers have not been receiving their share of the value of their timber crop. Also many of the trees for which they have failed to receive pay have been wasted by carelessness in cutting.

In all cases the owner should use a timber-sale contract, specifying the scale rule to be used, the money considerations, and the necessary provisions for cutting so as to perpetuate the timber growth.

Is there any further available information on how to measure and how to market timber?

Some of the State forestry departments and State colleges of agriculture have publications on this subject. The United States Department of Agriculture, upon request, will furnish copies of Farmers' Bulletin 1210, Measuring and Marketing Farm Timber.

How much profit is there in growing shortleaf pines as a crop?

The profit will vary with the region, kind of soil, trees per acre, and handling or care. It is not difficult to arrive at an approximate estimate.

Assuming that the owner has a good stand of pines that has been kept free from fires, and that he thins the trees two or three times at intervals of 5 to 10 years, and markets the trees thinned out for pulpwood, excelsior, or firewood, and cuts and sells at present prices the final crop when the trees are 40 years old, hauling all the products to the railroad, mill, or other market, a method of finding the net profit is as follows:

PROFIT FROM 1 ACRE OF PINES GROWN AS A CROP

(The main crop cut when 40 years old)

Money returns from timber:	
20,000 board feet of saw logs at $10 per thousand delivered at railroad or mill	$200.00
25 cords of pulpwood, excelsior wood, or firewood cut (in thinnings and main crop) and delivered at $5 a cord	125.00
	325.00

Cost of growing and marketing the crop:	
Rental of land worth $10 an acre for 40 years at 6 per cent compound interest	$92.85
Taxes at 10 cents an acre plus protection against fire and care, total of 15 cents an acre yearly for 40 years, at 6 per cent compound interest	23.21
Cost of logging and hauling logs and cordwood to railroad or mill (including wages for owner and team)	117.00
	233.06
Profit on timber crop: Clear profit per acre over 40-year period of growing the crop	91.94
In addition to good wages for man and team and 6 per cent compound interest return on the investment, yearly average net profit per acre	2.30

The prevailing local figures can be substituted in the above example, which may then show a higher or a lower yearly clear profit than the $2.30 an acre, over and above good wages for man and team and a 6 per cent return on the investment. This may fairly be looked upon as a satisfactory money return on lands that will not be needed for agriculture for a generation or two.

Can shortleaf be grown profitably for firewood?

A 25-year-old stand of shortleaf pine in Burke County, N. C., was cut and sold for firewood. It had come up in an old pasture three-fourths of an acre in area. It cut 30 cords or at the rate of 40 cords per acre. This is an average growth of nearly 2 cords per acre yearly.

An account was kept of the cost of each step in the operation and of the returns. Cutting cost $1.25 per cord and hauling to market $1.25, making the total $2.50 per cord. The wood sold for $5 per cord, which brought on a basis of 40 cords per acre a total return of $200. As the cost was $100, the profit was $100 per acre. Averaging this over the period of 25 years—the age of the trees—makes an average gross profit of $4 per acre yearly. If taxes, a fair rental, and interest charge on the land were deducted, undoubtedly there would remain a good net return.

Can shortleaf pine be worked profitably for turpentine and rosin?

Under the best conditions of high market prices and closeness to a turpentine still, it is doubtful whether it ever pays to work shortleaf for gum. During a recent year of high prices operators in southern Alabama cupped shortleaf pine along with the longleaf pine trees. (Fig. 17.) The difficulty lies in the rapid checking of the flow of gum, which makes the expense of chipping relatively very high for the amount of gum obtained.

How is growing timber like a savings-bank account?

The trees are the capital; the new growth is the interest. Shortleaf pine under protection and properly thinned grows rapidly in the South and brings in good interest in dollars and cents.

If the timberlands are cut too heavily, the capital is drawn from the woods bank and little interest is obtained. If the timber is worked wisely and only the amount of the new growth, or interest, cut, the capital in the woods bank will be left untouched. This will keep the lands growing timber at the maximum rate and make the largest profit for the owner. In a nutshell, good banking practice in the

growing of timber as a money crop is to use the ax and saw rightly and to keep out fires at all times.

REFORESTATION BY NATURAL SEEDING

If given a chance—that is, if an ample number of healthy seed-bearing trees are left on the land after logging, and if frequent and severe fires are prevented—shortleaf pine will fully restock the land. (Fig. 14.) It produces seed abundantly. The seed is very small

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FIGURE 17.—It is unprofitable at average current prices of naval stores to work shortleaf pine for gum. This operator was working all the shortleaf and longleaf trees on his farm-leased permit

(about 52,000 to the pound) and is easily blown because of the "wing" attached. If rightly handled, our shortleaf pinelands would all be well reset with pines, promising a good profit for their owners. Nature must operate under natural laws; therefore some mature seed-bearing trees should always be left standing.

Where do the seed come from?

From the cones, or burs, which mature and open in the fall. Each cone scale bears two seeds in hollows, or pockets, at its base, which may easily be seen upon examining an open bur. The small scales near the tip and base of the bur commonly do not bear fertile

seed. The burs start from very small female flowers that have been fertilized by pollen from the male flowers, and they require two seasons to mature. The pines all bear male and female flowers separately but both kinds on the same tree.

How often does a tree produce seed?

Not every year, but usually a heavy crop of seed about every third year, with often one and sometimes two light crops during the interval.

When do the seeds of shortleaf pine sprout?

Commonly in the spring, after lying on the ground over winter. Incidentally considerable loss of seed is sure to occur because squirrels, mice, birds, and insects eat them for food.

Are abandoned fields reseeding to shortleaf pines?

Yes; provided the field happens to have a goodly number of mature seed-bearing trees around it. Before timber became of much value—some 10 to 25 years ago—around or near fields there generally stood numbers of forest pines. These produced seed abundantly and started the dense or well-stocked stands of old-field pines now coming into value. (Fig. 18.)

Unfortunately, the greater number of the fields abandoned during the last 10 to 25 years have only a scattering of young pines. Possibly good stands of trees occur only over small portions of the fields near the margin of woods. Fields with scattering "bush" pines promise no crop except a small amount of very low-grade saw timber, pulpwood, or firewood.

REFORESTATION BY SPROUTING

Does shortleaf sprout?

Yes. Shortleaf pine sprouts vigorously and successfully to grow another crop of trees. Of all the important commercial pines in the United States, shortleaf alone has the power of complete reproduction by sprouting. (Fig. 19.) This very unusual property in large measure accounts for the splendid way in which shortleaf pine comes back as it does after repeated hot fires in the dry uplands, where it finds its natural home.

What is its capacity for sprouting?

Over large sections of the South where burning has long been the custom, practically all of the second-growth shortleaf pine trees are sprouts.

Fire and cutting are the chief causes for sprouting. A tree can sprout after repeated burnings or cuttings. (Fig. 20.) Three successive generations of sprouting have been identified and studied by the writer. The vigor of growth appeared to be as strong in the third as in the first generation.

After a tree reaches a size of about 6 to 8 inches in diameter, or an age of 10 to 18 years, depending upon the quality of the soil, it loses its power to sprout successfully. Under frequent and severe burning the young trees lose much of their vigor for successful sprouting.

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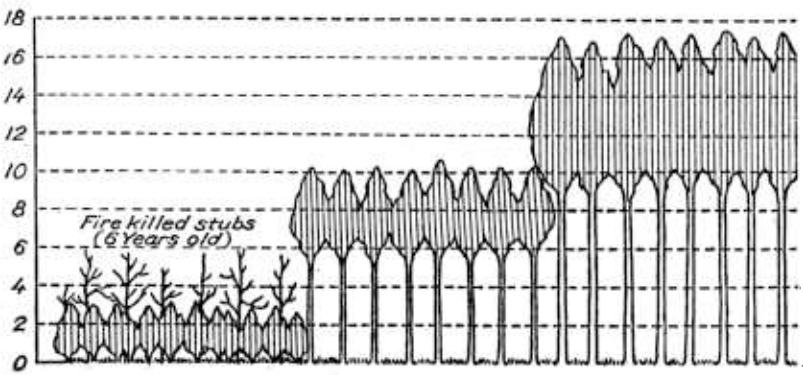
FIGURE 18.—Shortleaf pine trees that sprung from seed blown and collected in a furrow in an abandoned cotton field

F13034A AND F13844A

FIGURE 19.—Shortleaf pine comes back successfully by sprouting after being cut or burned when young; A, A vigorous 2-year-old sprout and the parent sapling killed back by fire (northern Georgia); B, Sometimes two sprouts grow to form trees (Arkansas)



Third generation:
4 feet high.
2 years old.

Second generation:
10 feet high.
8 years old.

First generation:
17 feet high.
10 years old.

FIGURE 20.—Three generations of shortleaf pine sprout trees growing vigorously. The parent trees were killed back by successive fires. The fires came from the left-hand side, and burned the dense stands as far as the ground had become dry

What causes the sprouting?

Just below the surface of the ground, where the stem and root system of the young tree meet, is a double crook, or knee, forming a short horizontal section at the top of the taproot. After fire or cutting kills back the tree above the ground, the small reddish-gray buds (adventitious buds), which occur on this horizontal portion of the stem and root, begin to develop into sprouts. If the stem is killed or cut in midsummer the succeeding sprouts are numerous and make a weak growth; if in winter, they are few and one or two (rarely three) grow vigorously upward, while the others spread horizontally and gradually die. In one season the sprout tree grows from 1 to 2 feet in height, or as much as a seedling tree grows in two to four years.

REFORESTATION BY PLANTING SMALL TREES

Pines grow from seed and may be set out like cabbage or tobacco plants.

On certain lands that have become denuded of pines, or on abandoned fields where no seed-bearing pines are near by, it is often good business to start pines by setting out small trees grown in nursery beds.

Is the direct seeding of land advisable?

Because of the high cost of pine seed and the usual heavy losses of seed sown on lands which it is desired to reforest, it is not practical at present to start young pines by direct seeding. However, improved methods may be found in the future for treating, or poisoning the seed, and for sowing it, which will make direct seeding a practicable method.

Thousands of worn-out fields in the Southern States are washing badly and growing up to briars, plum bushes, sassafras, or scattered bush pines. (Fig. 21.) They are practically idle and are not earning their taxes.

Idle lands mean a lowered income to the owner and to the county or State. This means a higher tax rate on the remaining productive lands.

If these idle lands were planted with pines, they would become a valuable asset to their owners and to the community and State.

Get in touch with your State forester at the State capital, your extension forester at the State college of agriculture, or your county agent, if you wish to put your vacant lands to work or make your timberlands most profitable.

How can shortleaf pine seedlings be obtained?

They may be dug up in abandoned fields or grown in prepared nursery beds from seeds or purchased from State or private nurseries. A number of the State forestry departments in the shortleaf pine region are growing pine seedlings for distribution to the public at nominal prices.

Small trees grown in the woods are slow growing and when 4 to 8 inches high may be from 3 to 5 years old. Such trees should not be used for planting, as they continue to make slow growth. The best are stocky or bushy seedlings 1 to 2 years old (or 3 years old in the more northern part of the tree range and if not over 8 inches in height) grown in recently abandoned fields or in loose soil along

F177245

FIGURE 21.—Ten years of soil washing on an abandoned hillside field, in the piedmont section of Georgia, showing the old terrace on the right. Pines, if started, would grow well, as shown by the vigorous saplings

stream washes. The root system should be much branched and well developed.

How can seedlings be grown in nursery beds?

Generally it is far better to grow shortleaf pine seedlings in nursery beds than to attempt to dig them in old fields. Dense patches of 2-year-old seedlings growing in loose soil and having the right sort of development are rarely found.

The nursery bed may well consist of a plot of ground 4 by 12 feet, or 4 by 16 feet or even longer, depending upon the size of the operations. It may be flush with the general level or slightly raised and confined or protected by 1 by 4 inch boards sunk 2 inches in the soil. The soil surface if raised much above the level is likely to dry out rapidly.

An acid soil gives the best results, as damping-off fungi are common and thrive in alkali or neutral soils. Old gardens should be avoided, unless fresh woods dirt or river silt (which are both acid) is brought in and used. The beds should preferably be located near the house or barn and always where supplies of water can be given during dry spells. A well-drained, sunny location should be chosen for pine seed beds.

In the early spring one-quarter pound of shortleaf pine seed, or about 13,000 seed, should be sown broadcast evenly over the well-worked soil in each 4 by 12 foot bed. The soil should, if possible, be worked first the fall before the sowing and again in the spring. Four 4 by 12 foot beds will be needed for a pound of seed. After being sown the seeds are pressed into the soil by a roller, plank, or spade, and covered by a layer of burlap or a thin sprinkling of fine sand, or better than sand, vegetable humus or fine leaf litter. It should be as free as possible from weed seed. The bed should be watched closely, and carefully watered in case of hot, dry weather. This period during the germination of the seed is critical, and the supply of moisture means either failure or success. If a burlap cover is used, it should be removed as soon as germination is visible, since the seedlings lift up the seed coats, much as do cucumbers and watermelons.

At the end of the season, the seedlings should be from 4 to 6 inches high and satisfactory for planting in favorable soil in the more southern States. However, if the lands to be reforested are dry or otherwise unfavorable or located in the mountains or more northern States, it will pay to use larger seedlings, grown for two seasons in the nursery beds or for one season there and one season in a transplant bed. The sturdiest and hardiest little trees for planting are those that have been transplanted from the seed beds at the end of one year, set about 2 inches apart in rows spaced 6 inches apart in beds, and allowed to grow for one year. They have the advantage of large root development.

How should nursery beds be protected and cared for?

Generally no wire screening is necessary for protection against birds and rodents, during the two or three weeks' period of germination, especially if the seeds are covered with a layer of burlap or gunny sack. If necessary, the sides and top of the bed should be covered with ½-inch mesh wire builders' cloth fastened over a light framing, as shown in Figure 22.

From the start all weeds should be pulled out when small; otherwise they will injure the pines when growing and when being pulled out.

A dense stand of pines of about 5,000 to 6,000 to the bed, or a few more than 100 per square foot, will require much soil moisture during hot weather; therefore the bed should be watered during dry spells. A thorough watering once in two or three days is far better than a light surface wetting every day. Furthermore, it requires less time.

During the summer the pine seedlings will require partial shade from the sun (fig. 22), especially if good watering arrangements are not provided.

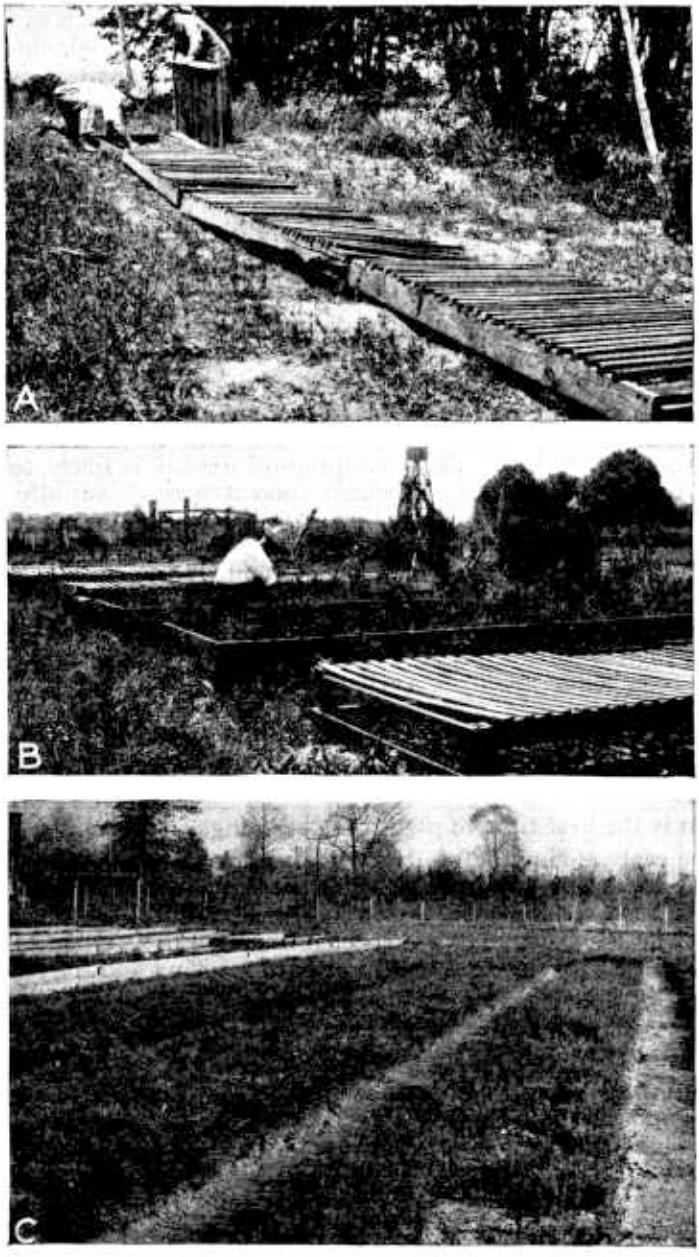


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FIGURE 22.—Various types of nursery beds for growing pine seedlings. A good size is 4 by 12 feet. Shade should be provided, also good watering facilities in the summer time. A, Crude type of bed with 1 by 8 boards set about 2 inches deep in the soil. The lath shade frames should be of light construction. B, A nursery of the Southern Forest Experiment Station. C, Where water is used plentifully in dry weather, shading may be unnecessary

Each bed should be protected with two sections of lath screen, each 4 by 6 feet. The shade frames can be made of 1 by 2 inch strips, with proper bracing, covered with laths spaced about 1½ inches apart. About 50 laths will be required for the two sections. This construction will afford one-half shade. The frames should be supported at a height of about 18 inches above the ground by three crossbars resting on stakes. The frames should be strong enough to stand necessary handling. If water is applied freely during all dry periods, the shading is unnecessary.

Moles sometimes cause trouble and may be kept out by encircling the bed with a narrow trench filled with lime or by sinking a strip of half-inch wire mesh to a depth of 1 foot around the bed.

What should be done to combat damping off and weeds in nursery beds?

Damping-off fungi sometimes cause serious injury and loss during the first two or three weeks after germination. They attack the tender roots and later the stem at the surface of the ground, causing wilting and quick death. The damping-off disease is likely to occur during hot, moist weather, at which time it spreads rapidly. The remedy is, if possible, to dry out the soil in the bed by giving it better ventilation. A thin layer of dry sand sprinkled over the surface of the soil is said to be helpful. Lime should never be used. The spores of this fungus are present in almost all old gardens and cold-frame beds; it is therefore advisable to make the bed in new soil or to bring such soil in for use in the bed.

Tests are being made of various chemicals for killing out the damping-off fungi, and also weeds. Different soils appear to require different treatments. Further information can be obtained by writing to the Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C.

When is the best time to plant pine seedlings?

In the early spring, before the buds begin to swell, the conditions are most favorable for planting pine seedlings. Late-fall planting may give good results if the season happens to be wet and the winter mild, but much injury may be expected during a dry fall and during a severe winter, because of frequent or hard freezing and the resulting upheaval of the soil. If planted in the late spring after the new growth has started pine seedlings are very likely to die.

What are the important directions for planting pine seedlings?

The seedlings should be carefully dug and lifted from the nursery bed so as not to damage unnecessarily the fine rootlets. All underdeveloped seedlings should be thrown away, since it is an expensive mistake to plant spindling or sickly small trees. The taproot, if over 6 inches long, should be pruned back with a sharp knife. The roots at all times must be kept wet; hence the seedlings should at once be placed in tubs or buckets with water or wrapped in wet moss or gunny sack. If not wanted at once for planting, they should be heeled in, in fresh soil, always in a cool, shaded place, and the soil never allowed to dry out. The leaves should be left exposed freely to the air but never to direct sunlight.

A good method of planting pines in open ground is to run furrows 6 feet apart to break up the soil and mark off the land. The trees are then set in the furrow about every 6 feet. This requires 1,210 trees per acre. The more fully the ground is broken up in the furrow or furrows in advance of planting the more rapid will the growth be. Weed competition is also checked. It will be found

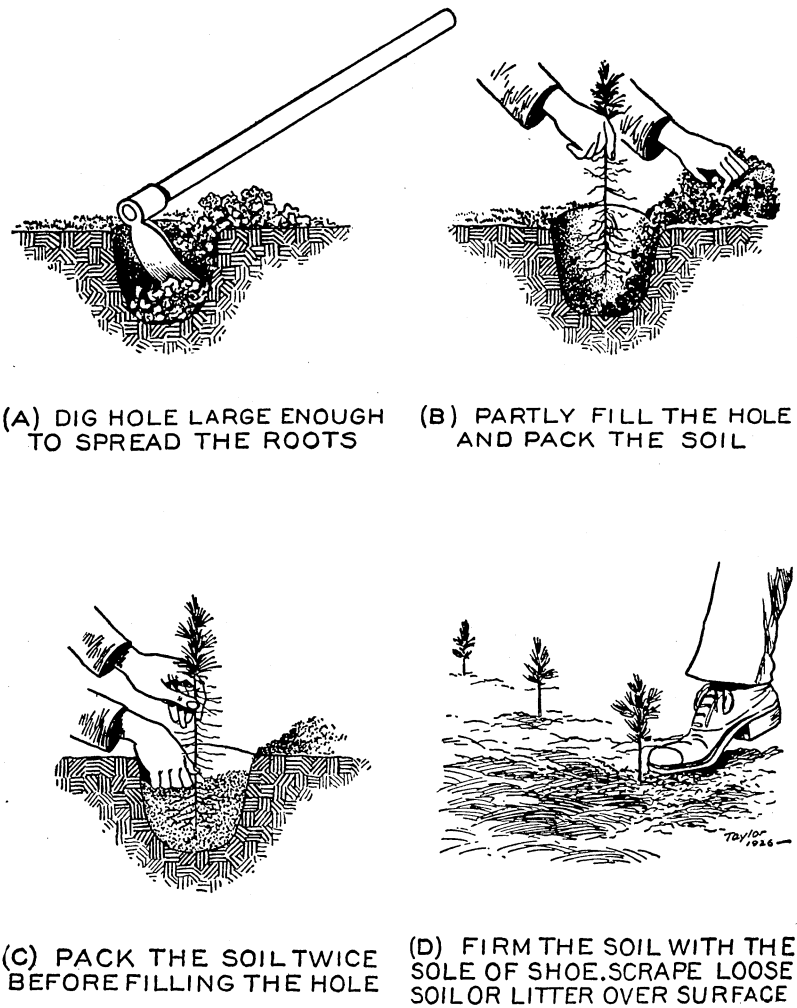

FIGURE 23.—How to plant small pines with a mattock or grub hoe. The land may be furrowed before planting and a dibble (fig. 24, B) may be used instead of a mattock

impracticable to do more than simple inexpensive preparation of the soil in starting a young forest.

Some essential points in good planting of small trees are as follows: A hole is opened only a little larger than is needed to spread out the roots. Holes are often dug too large and trees left too loosely set in the ground. A mattock (mattax) or a grubbing hoe is a good tool for use in planting. (Fig. 23.) The seedling tree is set with the

roots spread in as natural a position as possible, the taproot being kept always straight down. Soil is then scraped in about the tree, which should be set just a little deeper than it grew in the nursery bed. The soil is then firmed, and the filling-in and tamping process

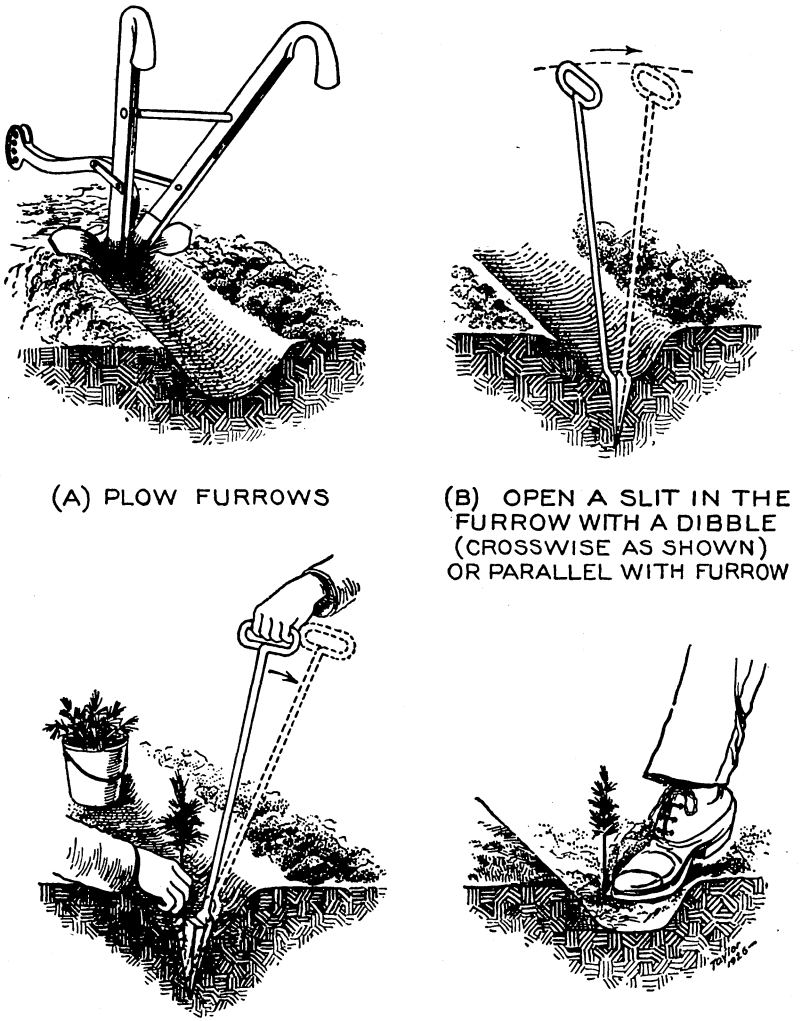

FIGURE 24.—How to use a dibble in planting small pines. The dibble opens a narrow slit in the soil in which the seeding pine is planted. Then the soil is pushed up against the roots. A mattock (fig. 23) may be used in planting in furrows instead of the dibble

is usually repeated in order to avoid rapid drying out. The sole of the shoe will be found suitable for this purpose. A little straw or loose soil scraped about the tree will act favorably as a mulch against rapid drying. The trees to be planted should be carried about in

buckets containing water and the roots should be kept in water or preferably in a clay puddle.

In loose open soil a planting iron, or dibble, may be used advantageously. (Figs. 24, 25, and 26.) It is a straight, thin blade on a handle and is used to open a slit and to close it after the little tree has been set in the slit. (Fig. 24 C.) In loose soil two men or a man and boy should set an average of about 2,000 trees per day with a dibble, or nearly twice as many as by using a mattock in firm soil.

Advantage should be taken of favorable weather. Cloudy weather following rains affords ideal conditions. After planting, no further attention will pay, except protecting the trees at all times from fire and hogs or other injurious livestock.

No livestock should be permitted to run over land set in pines for at least the first five years, and fire should be excluded at all times. (Fig. 29.) Watering or cultivating the trees in a forest plantation

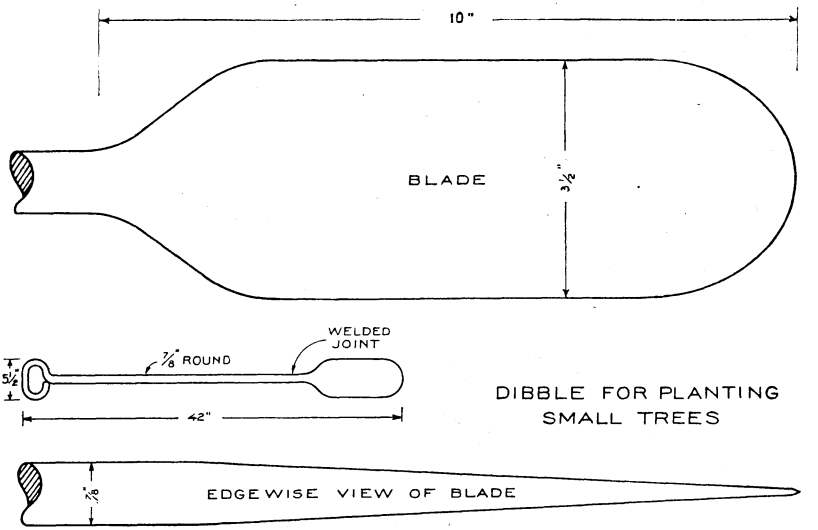

FIGURE 25.—The dibble is much used for planting small seedling pines. It has a thin, flat steel blade attached to a steel or, less serviceably, a wooden handle

is impracticable from a financial standpoint. The case is different where a few trees are set out for ornamental purposes.

In a forest plantation the loss up to 15 per cent of the total number of trees set out is not an uncommon experience. Among the causes are the use of poor grade of trees and drought at the time of planting or soon after. If any considerable loss occurs it is good practice to reset the blank places the next spring or a year later.

Where can shortleaf pine seed be obtained?

It may be collected from trees or purchased from dealers. So far as possible seed should be obtained in the same locality in which the young trees are to be planted.

Pine seed is most economically obtained from trees felled in logging. Any time after the burs begin to turn brown in the fall the seed is ripe and may be collected. The burs should be pulled off the tops, collected in burlap or gunny sacks and later spread out to dry

on a tight floor or on canvas in the sun. In drying weather they will open in a few days, and if they are then beaten or stirred the seeds will fall out. The wings cling tightly to the seed and in ordinary practice no attempt is made to break them from the seed. Sometimes the seed may be quickly obtained directly from the felled tree tops by beating the open burs with a stick while holding a sack, tub, or bucket under them. About 2,000 unopened burs make a bushel.

In favorable seasons where logging is in progress shortleaf pine seed may be collected for as low as $2 a pound, but it often costs from $3 to $4. There are about 52,000 winged, clean seed in a pound. Commercial dealers make an additional charge for handling and to pay for some inevitable loss incident to keeping fresh stock on hand. The seed commonly retails at $6 to $8 per pound. Thus far the

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FIGURE 26.—Planting pines in furrows in open sandy land by the use of a planting tool, or spud, known as a dibble. This makes possible the rapid planting of small trees in loose soil

demand for pine seed has not been strong enough to result in much competition or low prices. At intervals of every two to three years any specified tract or stand of pines will usually produce a heavy seed crop. Inquiries as to where shortleaf pine seed may be obtained and a list of commercial dealers, should be directed to the State forester, the extension forester at the State agricultural college, or the Forest Service, Washington, D. C. In buying pine seed fresh stock should always be specified. Pine seed average only about 60 to 70 per cent of good seed, varying more widely in good or bad seasons.

What does it cost to plant an acre of pines?

Much depends upon the scale of the operations and the condition of the soil. It is assumed that the trees are set 6 by 6 feet apart, or 1,210 per acre. If the seedlings are grown in nursery beds at home,

the actual expense may be no more than the cost of the seed, from 20 to 40 cents, and the value of the time put in in growing and setting out the little trees. Two men, or a man and a boy, working with a mattock in average soil, should set an acre of pines (1,210) in a day. In loose fresh soil the two workers, using a dibble, should be able to plant 2,000 trees. These estimates are for open, smooth ground, and must be reduced by one-fourth to one-half in rough hilly land. Furrowing the ground would add another item of expense. These figures will indicate the probable cost of reforesting land. Large operations are cheaper proportionately than small ones.

Are there any planted shortleaf pine stands?

Yes. Young planted stands up to 5 to 8 years of age are to be found in many of the Southern States. (Fig. 27.) In Spalding County, Ga., and in Alamance County, N. C., are excellent stands of

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FIGURE 27.—Five-year-old shortleaf pine planted as 1-year-old nursery-grown seedlings in a worn-out field in the piedmont clay soil region, Iredell County, N. C.

a few acres of shortleaf pine from 35 to 40 years old. (Fig. 28.) Near Biltmore, N. C., are many acres of shortleaf pine planted from 1896 to 1907, both in pure stands (shortleaf pine only) and in mixture with forest trees of other kinds. Younger plantations are to be found in several other States.

PROTECTION OF THE GROWING CROP

Is burning the woods injurious?

The damage and loss to forest growth caused by fire exceeds the combined effect of all other injurious agencies. (Fig. 29.) At the same time, this cause of injury is chiefly man-made and of all the sources of injury can be most readily controlled.

The yearly burning of the woods, extensively practiced in some parts of the natural home of shortleaf pine, has been done with little

F186388

FIGURE 28.—A planted forest, probably the oldest in Dixie's Land. These stately rows of shortleaf pines are the result of planting 10 acres of worn-out cotton fields with pine seedlings in 1892, near Griffin, Ga. The trees were set 8 by 8 feet apart in rows following the terraces. When 35 years old, the trees were 45 to 60 feet in height and from 9 to 14 inches in diameter. The forest is perfect, with dense shade and a thick mat of pine litter protecting the soil and conserving the moisture. The trees have never been injured by a fire

realization of the enormous damage to the timber and forest land and of the money loss to the owner. Although shortleaf pine sprouts successfully when young (pp. 27, 29), fire sets the trees back, causing a loss of time, and has other very injurious effects.

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FIGURE 29.—Fire in shortleaf pine cutting; A, Sweeping through the tops, killing many trees; B, Nearly every tree is blackened and killed by fire. Over 1,000 board feet per acre of good lumber left in high stumps

How does fire affect growing trees?

Fire makes scars ("cat faces") on trees. It so weakens their vitality that insects and fungi find it possible to prey upon the trees, often causing their death.

The stripping of the woods mold off the ground takes away nature's fertilizer; it also removes from the soil nature's mulch, or "clothing" intended to protect the soil and the tree roots against be-

coming hot and dry in midsummer. When they become hot and dry, as they do wherever the woods humus is lacking, the tree almost ceases to grow during portions of midsummer, for it must have water in abundance.

Fire burns back young growth, or in very dry times so weakens the saplings that they fail to sprout.

> Pine timber grows rapidly when the trees are given enough growing space and are kept from harm by fire. Timber often pays all the farm taxes—grow it as a crop.

What value has shortleaf "pine" straw as a fertilizer?

According to a recent analysis by the Bureau of Chemistry and Soils, United States Department of Agriculture, a ton of dead leaves or "straw" from shortleaf pine trees contains the fertilizing elements and has the value shown below:

Nitrogen, 14.2 pounds, worth at 15 cents per pound wholesale prices	$2.13
Phosphoric acid, 5.4 pounds, worth at 5 cents per pound wholesale prices	.27
Total value of fertilizer	2.40

The straw has additional value as organic matter. When applied to a piece of crop land, pine straw forms humus or woods mold, which has a high moisture-holding capacity and makes for better aeration of the soil, both important to the health and vigor of growing plants.

What damage is caused by insects?

The southern pine bettle attacks living trees. Outbreaks of this beetle almost invariably occur only during years of extreme drought or locally in places where little rain has fallen for two or three months of the growing season. It is important that close watch of pine stands be kept during unusually dry periods. The adult is a small, dark-brown beetle. In the soft inner bark of the tree it lays eggs which hatch into grubs, often known as "worms." These feed on the rich living layer of inner bark and new wood, thus girdling the tree and causing its death. The life history of this insect is known, and information regarding measures for checking its depredations can be obtained from State entomologists or the Bureau of Entomology, United States Department of Agriculture, Washington, D. C., which has issued a circular for free distribution on the southern pine beetle.

The pine sawyer is a large beetle whose larva, a white grub, bores into the sapwood of dead or felled timber. Its activity may be checked by peeling and drying the timber or immersing it in water.

Young shortleaf pines are sometimes injured by the Nantucket tip moth which attacks the tender young shoots in the early summer. The shoots are often killed, and as a result the tree becomes somewhat deformed and its rate of growth is slowed up. Most trees outgrow the attack successfully. No practical means has yet been found for checking this insect. The references given above should be used in seeking further information upon this important subject.

Are pine trees subject to diseases?

Second-growth, or sap pine under 50 years old, is little affected by "red heart" or other fungous diseases. Wounds caused by fire admit the spores, or "seeds," of fungi, but, as a rule, the vigorous young trees are able to combat them successfully. Probably the antiseptic qualities of the crude turpentine, or gum, help in this matter. After the tree reaches middle age or more advanced ages, red heart is not an uncommon enemy, gradually eating away the heartwood and thus weakening the tree as well as destroying the value of the affected wood. The best protection is to keep out all fires and cut and utilize trees as soon as they show the "bumps," which are good indications of the presence of disease.

There is plenty of land on farms for growing timber as a crop after all the better lands are used for other farm crops and for pastures.

No farmer can afford to pay taxes on idle land. Forest conservation on the farm has come to be a matter of economic necessity.

Forests, unlike many natural resources, can be used and regrown forever. Continuous production of tree crops on lands best suited for the purpose is the aim of forestry.

Since timber and wood are required for the successful operation of the farm, and since most farmers have some lands best adapted to tree growth, the growing of timber as a crop is legitimately a part of the farm program.

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